

A NEW SKINK (REPTILIA: SAURIA: *LEIOLOPISMA*) FROM FIJI

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Abstract.—A new lizard, *Leiopisma alazon*, is described from the southernmost island cluster, Ono-i-Lau, of Fiji. This species represents the first record of *Leiopisma* from the Fijian Islands. *Leiopisma alazon* shows no evidence of close relationship with its nearest geographic congeners on New Caledonia. Instead, *L. alazon* does show a relationship to the New Zealand “*leiopisma*” skinks and is most similar to the species of *Cyclodina*, except by its possession of a transparent palpebral disc in each lower eyelid. To facilitate comparison with New Caledonian *Leiopisma*, the latter were studied and five species groups are tentatively recognized.

The skinks of the Fiji Islands have long been known to represent three genera: *Cryptoblepharus*, *Emoia*, and *Lipinia*. A fourth genus, *Eugongylus*, may occur in the Fijian group, but its presence remains unconfirmed. Thus, the discovery of a different lygosomine skink in the Ono-i-Lau group was a great surprise, particularly since the new species was found on only the smallest island of the three searched in this group.

The new skink possesses an alpha palate, 11 premaxillary teeth, and toes covered dorsally by a single row of scales, characters of Greer's (1974) group II skinks. It can further be recognized as a member of the genus *Leiopisma* by moveable lower eyelids with a large transparent palpebral disc in each lid and well developed prefrontal scales. *Leiopisma* is predominantly a Southwest Pacific group with species on Lord Howe Island, New Caledonia, New Hebrides, New Zealand and Chatham Islands, Australia, and Tasmania (Greer 1979). Because the specimens from Ono-i-Lau differ in several features from the other species of *Leiopisma*, the Ono-i-Lau population is described as:

Leiopisma alazon, new species
Figs. 1, 2

Holotype.—USNM 230000, adult male; Fiji, Ono-i-Lau, Yanuya Island, 20°37'S 178°41'W, coll. George R. Zug, 29 Apr 1982.

Paratopotypes.—USNM 229989 (cleared and stained), USNM 229990–9999 (alcoholics), juveniles, females, and males with same collection data as holotype.

Diagnosis.—This skink is a small *Leiopisma* with an adult snout-vent length (SVL) of 45–65 mm, a robust elongate body, short but well developed limbs, a pair of frontoparietal scales, prefrontals not in contact, smooth dorsal scales, 34–37 scale rows around midbody, and an orange to red tail in adults. These features, singly or in combination, distinguish this species from all currently recognized *Leiopisma* species. The Australian species *L. duperreyi*, *L. greeni*, *L. metallicum*, *L. ocellatum*, *L. palfreymani*, *L. platynotum*, *L. pretiosum*, and *L. trilineatum* possess a single (fused) frontoparietal scale; *L. baudini*, *L. coventryi*, *L. en-*

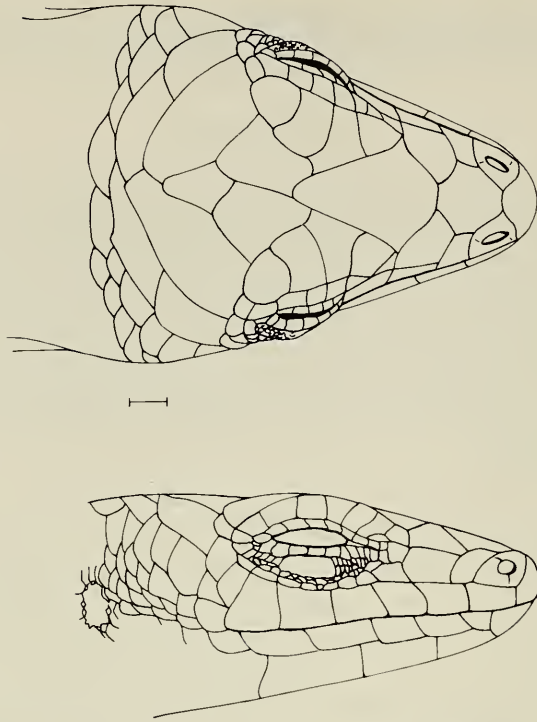


Fig. 1. Dorsal and lateral view of the head of *Leiolopisma alazon*. Based on the holotype, USNM 230000. Inset 1 mm.

trecasteauxii, and *L. zia*, have fewer than 34 scale rows around midbody; *L. spenceri* has supernasals; adult *L. lichenigerum* has SVL greater than 75 mm. No New Zealand *Leiolopisma* possesses a uniform reddish or orangish tail dorsally. The majority, *L. acrinatum*, *L. chloronoton*, *L. fallai*, *L. gracilicorpus*, *L. grande*, *L. homalonotum*, *L. infrapunctatum*, *L. lineocellatum*, *L. nigriplantare*, *L. ottagense*, and *L. suteri* also have adult SVL greater than 75 mm. *Leiolopisma fasciolare*, known only from the original description, has 27 scale rows around midbody. The majority of the New Caledonian species, *L. austrocaledonicum*, *L. deplanchei*, *L. euryotis*, *L. novacaledonicum*, *L. steindachneri*, *L. tricolor*, and *L. variabile*, have a single frontoparietal. *Leiolopisma greeri* and *L. nigrofasciolatum* have large prefrontals broadly in contact medially.

Description of holotype.—Adult male of 60.4 mm SVL and 46 mm tail length (regenerated); general habitus of elongate and robust body, head triangular in outline, depressed and rounded snout, limbs short but well formed, robust and subcylindrical tail gradually tapering to point. Head length (tip of snout to ear opening) 12.4 mm, head width (at angle of jaw) 9.0 mm, snout to naris distance 1.1 mm, axilla to inguen (trunk) length 34.8 mm, hindlimb length 16.0 mm. Forelimb (length, 12.3 mm) shorter than hindlimb; no overlap when adpressed.

Rostral wider than high, in broad contact with frontonasal; prefrontals moderate-sized, paired, and widely separated by frontal-frontonasal contact; fronto-nasal octagonal, width and length subequal, in broad contact with frontal; frontal



Fig. 2. Dorsal view of *Leiolopisma alazon* (USNM 230000).

truncated rhomboidal, length twice width, in broad contact with frontoparietals; frontoparietals paired, somewhat rhomboidal, length slightly greater than width, bordering interparietal and parietals posteriorly; interparietal large, approximately half area of frontoparietal, rhomboidal, width approximately two-thirds length; parietals paired, trapezoidal, length two to three times width, bordered posteriorly by pair of large nuchal scales and upper secondary temporal scales. Nasal large, obovate, grooved, naris circular and nearly centered in scale; anterior loreal higher than wide; posterior loreal wider than high; upper and lower preoculars large, contiguous with row of small, distinct suboculars separating labials from lower eyelid scales. Four large supraoculars on each side; 9 supraciliaries; 10 upper eyelid scales; anteriorly an accessory supraciliary between second supraciliary, eyelid, and upper preocular; 3–4 postoculars; lower eyelid with large palpebral disc, 1.1 mm in maximum length; primary temporal and pair of secondary temporals on each side; upper secondary temporal largest and on posterior border of parietal. Supralabials 7, fifth beneath eye, sixth highest; infralabials 6; mental semicircular; postmental large and pentagonal; 3 pairs of chinshields, first pair largest and only pair in contact medially. Ear openings vertically elliptical, 0.6×1.3 mm.

Dorsal scales smooth, in 70 transverse rows from base of tail to nuchals; 36 rows of scales around midbody; ventral scales slightly larger than dorsals and laterals; preanals slightly larger than preceding scales; 14 smooth lamellae beneath fourth finger; 21 smooth lamellae beneath fourth toe. Finger lengths, $3 = 4 > 2 > 5 > 1$; toes, $4 > 3 > 2 > 5 > 1$.

In life, dorsum with brownish olive ground color, spotted with light golden or beige and dark brown scales; labial and mental area with dark brown streaks or spots; venter golden beige; tail rufous orange above and below. In alcohol, dorsum brown with scattering of dark brown and beige spots; dark brown spots concentrated dorsolaterally to give impression of stripe from posterior edge of eye to inguen; sides light brown, rapidly grading to cream colored venter; head brown dorsally with few dark specks, upper and lower lips with dark brown bars that extend onto chinshields; limbs beige with numerous dark brown spots dorsally; tail orangish beige dorsally and laterally, cream ventrally.

Variation.—The paratopotypic specimens are all smaller than the holotype. The two females (USNM 229990, 229998) are 48.1 and 42.7 mm SVL, respectively; both appear mature or are maturing because each contains small, but vitellogenic, follicles. The remaining specimens are males, ranging from 26.9 to 57.7 mm SVL. The smallest may be a hatchling/newborn, since it possesses a ventral scale aberration which may be a yolk-sac scar. Two males (51.3 and 57.7 mm SVL) have large testes and epididymides and are presumed mature. The other males (33–49 mm SVL) are immature with small testes. In all specimens, original or completely regenerated tails are equal to body length or slightly longer, robust, cylindrical with gradual taper to the tip. The head is triangular on all specimens with a head width to head length proportion of 0.67–0.74. The limbs are well formed and short. The hindlimb and forelimb when adpressed to trunk remain widely separated. Trunk length (measured between fore- and hindlimbs) is approximately half the snout–vent length (48–58%, mean 53%).

Dorsal head scale pattern is relatively invariable; the differences are minor shape and positional alterations. Only the supraciliaries vary in number, 8–9; 8 supraciliaries is the modal number with 9 resulting from a division of the second supraciliary. The lateral head scales are somewhat more variable in size, shape, and position. The upper eyelid bears 8–11 scales, mode 10. The nasal retains the obovate to parallelogram shape; naris is typically central, but in some individuals, the naris is shifted anteroventrally toward inferior border; posterodorsal and medioventral grooves extend from the naris in a few individuals, never creating a distinct division of the nasal, ventral groove most prominent when present. Anterior and posterior loreals are higher than wide and wider than high, respectively, as in the holotype, although the width of the anterior loreal varies from approximately two-fifths to half of the height and, in the posterior loreal, the shape is rectangular to weakly trapezoidal. The preoculars are paired in all specimens, the upper usually equal in size to lower, occasionally smaller. The subocular row is complete in all individuals; although in two individuals, the suboculars above the fifth supralabial are only slightly larger than the scales covering the lower eyelid. The suboculars grade imperceptibly into the postoculars; one postocular is always wedged between the last two supraciliaries. Similarly, there are one or two small scales wedged between the first and second supraciliaries and the anterior upper eyelid scales. Of the temporals the size ranking of small to large is invariably primary, lower secondary, and upper secondary. There are 7 supralabials, fifth beneath orbit, and 5–7 infralabials, mode 6, in all specimens. Ear opening is elliptical and subequal to palpebral disc of lower eyelid in all. Low rounded auricular scales are barely evident along anterior margin, 2 or 3 in number.

All body scales are smooth. The dorsal scales lie in 71–77 transverse rows, mean 73.8, from base of tail to nuchals. There are 34–37, mode 34, scales around midbody. The fourth finger bears 12–15 lamellae, mode 15, the fourth toe 20–23 lamellae, mode 22.

In life, all individuals had the same coloration and general pattern as the holotype; however, there was a single striking difference in tail color. USNM 22989–95 had tails in shades of salmon, 229996–99 in shades of beiges; these colors were as evident ventrally as dorsally. Tail color differences have no association with size (age), sex, or reproductive condition. In alcohol, dorsal ground colors range from tan to brown with a various density of dark brown spotting. In all, there is a concentration of these spots into an interrupted dorsolateral stripe on each side. In individuals less than 55 mm SVL, these dark spots are dense and arranged into ragged-edged, irregular transverse bars.

Etymology.—The name “alazon” is Greek (neuter) for wanderer or rover. It is used in allusion to this species wandering from the common geographic track (New Caledonia through New Zealand to Australia) of Pacific *Leiolopisma* as well as to its dispersal to the remote Ono-i-Lau group.

Ecological Observations

Yanuya Island is a small coral island, probably less than a hectare in area, in the Ono-i-Lau cluster. It is a fairly flat island with only scattered, irregularly spaced limestone outcrops, of 2–4 m in height. The entire island is covered by forest; the canopy is nearly closed at approximately 10 m. The island serves as a rookery area for brown boobies and sooty terns. Presumably, the rookery accounts for the presence of a sandy humus-like soil and the reported presence of “plenty snakes,” presumably the boid *Candoia bibroni*. The forest floor had a light scattering of leaves and fallen limbs. All but one of the *Leiolopisma alazon* were in or under rotten logs; the single exception was a juvenile caught resting on a blade of grass.

The smallest specimen (26.9 mm SVL) appears to have a yolk-sac scar and, hence, may have been recently hatched or born. However, in “*leiolopisma*” of similar adult size (e.g., *Lampropholis delicata* & *quichenoti*; Clarke 1965), one week old juveniles have 17–20 mm SVL. Since none of the females were gravid or pregnant, it is impossible to declare this species as ovi- or viviparous. Both females (42.7 and 48.1 mm SVL) possess small, but clearly vitellogenic follicles. The smallest male with well developed testes and epididymides is 51.3 mm SVL; a male of 49.3 mm SVL has small testes and is likely immature. These data suggest a sexual dimorphism in body size with females maturing at a smaller size than males.

Three other lizard species were seen or captured on Yanuya: *Cyrtodactylus pelagicus*, *Emoia cyanura*, and *Emoia* cf. *samoensis* complex. *Emoia cyanura* was the most abundant of the Yanuya lizards. *Cyrtodactylus* is the only species sharing the same microhabitat as *Leiolopisma*, but the two were not found under the same logs.

Leiolopisma was not found on either of the two other larger islands visited in the Ono-i-Lau cluster. Davora Island lacks a humus-like soil, having only a fine coral rubble with a dead leaf cover; *Lipinia noctua*, *Cryptoblepharus*, and *Emoia*

cyanura were present. Estad Island is a sand island with partially humus-like soil; only *Emoia cyanura* was observed.

Distribution and Relationships With Other Oceanic *Leiolopisma*

The occurrence of a *Leiolopisma* in the southern Fijian Lau group seems anomalous, but then the distribution of the genus *Leiolopisma* is a peculiar one. The occurrence of the type-species of *Leiolopisma* (*L. telfairi*) on Round Island of the Mauritius group in the western Indian Ocean with all other representatives in the Southwest Pacific makes little zoogeographic sense, no matter how ardent a supporter one is of long distance dispersal or vicariance. On zoogeographic grounds, *Leiolopisma* currently appears to be a polyphyletic group and with further study is likely to be divided into the West Indian Ocean *Leiolopisma* and a Southwest Pacific group of one or more genera¹; however, such a taxonomic reshuffling is well beyond the scope of the present study. Considering only the distribution of the Pacific *Leiolopisma*, the pattern still remains unique among the Pacific herpetofauna, since it is J-shaped incorporating the New Caledonian cluster southward to New Zealand and westward to center on southeastern Australia and Tasmania. Within each of the aforementioned areas, the genus has undergone great diversity. The origin of this pattern has been variously explained. Although Brown (1956) does not address this pattern directly, he does suggest that the Loyalty and New Caledonian fauna derive largely from the Australian region. Towns (1974) treats the origin of the New Zealand skink fauna and recognizes four possible dispersal routes: 1) Australia-Tasmania track; 2) Fiji-Tonga-Kermadec track; 3) New Caledonia-Norfolk track; 4) Australia-Lord Howe track. Towns' analysis does not eliminate any of these tracks as a possible dispersal route and, although he seems to favor the two Australian tracks, he also advocates the Fiji-Kermadec track for the *Leiolopisma suteri-lichenigerum* group. Greer (1974) labels the *Leiolopisma* pattern as relictual; he further suggests that the diversity of *Leiolopisma* at the periphery of the major radiation of skinks may result from *Leiolopisma* being at a competitive disadvantage with the more advanced skink genera. However, he also suggests Australia as the source area for the eastward dispersal of *Leiolopisma* into the Southwest Pacific. Hardy (1977) proposes the Sulawesi-New Guinea region as the source area for the ancestral *Leiolopisma* stock which, with multiple invasions, entered Australia and New Caledonia; New Zealand in turn received multiple invasions from these two source areas. Only Hardy's interpretation is based on hypotheses of interspecific relationships and, hence provides rational estimates of vicariance tracks or dispersal pathways. The presumed close relationship of the Australian *L. coventryi* and *L. entrecasteauxii* with the New Zealand *Leiolopisma* species and with the New

¹ Recently Greer (1979) split Pacific *Leiolopisma* into two genera, the alpha palate *Leiolopisma* and the beta palate *Lampropholis*. Earlier Hardy (1977) divided the New Zealand *Leiolopisma* species into the scaly eyelid *Cyclodina* and the palpebral disc eyelid *Leiolopisma*. Other genera are likely to be recognized in the future, because, even now, the division of "leiolopisma" skinks is uncertain. Greer (1979) does not recognize *Cyclodina* or *Pseudemoia*. My usage of *Leiolopisma*, thus, straddles the recommendations of Hardy and Greer. I anticipate that in the future *alazon* will be re-assigned to a currently unrecognized genus, such as *Oligosoma*.

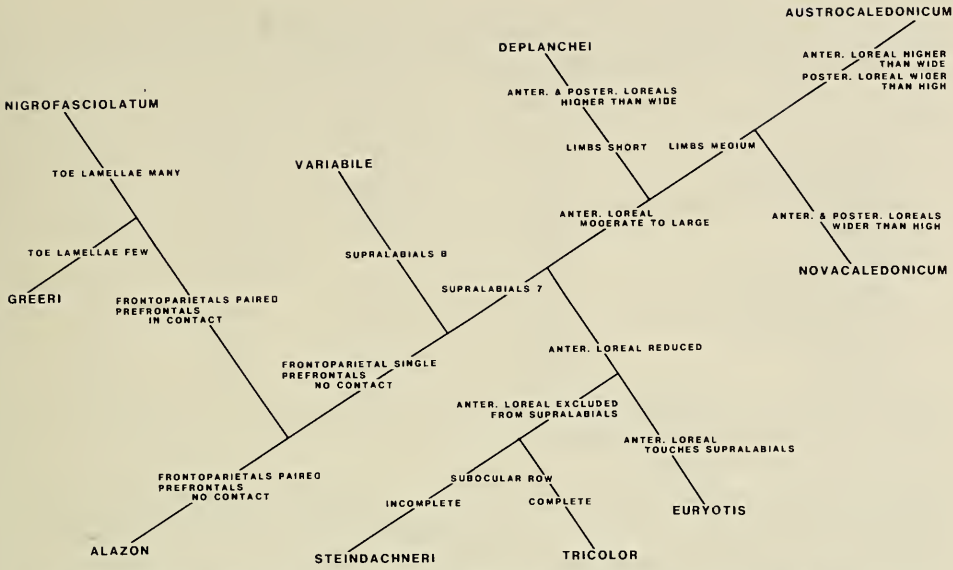


Fig. 3. Taxon and character phenogram of the major species/forms of New Caledonian *Leiolopisma* and *L. alazon*. The resulting clusters of species/forms likely indicate some degree of relationship; however, hypotheses of relationships require the establishment of character state polarities and an analysis of a wider array of morphological characters.

Caledonian *L. nigrofasciolatum* suggested to Hardy that the Southwest Pacific *Leiolopisma* had their initial center of divergence in New Caledonia and one stock reached Australia via the Eastern Australian Current, and another stock reached New Zealand by the tropical cyclone trackway. If dispersal of *Leiolopisma* is aided by oceanic currents and/or cyclonic storms, only the latter seems likely to have placed *Leiolopisma* in the southern Lau group of Fiji, since the general flow of ocean currents is westward and southwestward through the Fijian islands. The storm track would have to have been a highly irregular one to have crossed the New Caledonian and Loyalty region and then traveled 1300 km east-northeast to the Lau islands.

Such an interpretation of the presence of *Leiolopisma alazon* in Ono-i-Lau is highly speculative, but seems more reasonable than an upcurrent dispersal of 1450 km from New Zealand. If this interpretation is correct, the closest relatives of *L. alazon* should be with the New Caledonian species; however, such a relationship is not strongly supported by the evidence (external morphology) currently available to me.

From a strictly phenetic viewpoint, I recognize five species groups of New Caledonian *Leiolopisma* (*nigrofasciolatum*, *variable*, *euryotis*, *deplanchei*, and *austrocaledonicum* groups; Fig. 3 and Tables 1 and 2). Note that this arrangement is very tentative, since I have not examined representatives of all species and have, of necessity, relied on literature descriptions. The *nigrofasciolatum* group shares with *alazon* paired frontoparietal scales and high numbers of dorsal trunk and midbody scale rows; otherwise, they are very dissimilar owing to the strikingly different body form of a long thin trunk, pointed head, and long slender limbs of

Table 1.—Character matrices for Fijian and New Caledonian *Leiolopisma*. Body measurements and proportions (means). Abbreviations: BL, body length; HbL, hindlimb length; HL, head length.

Taxon	Minimum adult SVL (mm)	HL/SVL	HbL/SVL	HbL/BL
<i>alazon</i>	45–50	0.21	0.29	0.56
<i>austrocaledonicum</i>	40	0.20	0.43	0.86
<i>deplanchei</i>	35 (?)	0.20	0.29	0.60
<i>euryotis</i>	35 (?)	0.21	0.42	0.82
<i>greeri</i> *	60	?	?	?
<i>nigrofasciolatum</i>	80	0.20	0.41	0.82
<i>novaecaledonicum</i> *	60	0.21	0.39	?
<i>steindachneri</i>	50 (?)	0.25	0.47	1.08
<i>tricolor</i>	45–50	0.22	0.44	1.01
<i>variabile</i>	80	0.23	0.57	1.33

* Data derived from original description.

nigrofasciolatum group members. *Leiolopisma variabile* shows no similarity to *L. alazon*; in fact, *L. variabile* is unlike any other New Caledonian *Leiolopisma*. *Leiolopisma variabile* shares body size and shape with *L. nigrofasciolatum*, but its meristic characters are strikingly different, particularly such features as the granular-scale patch on the posterior surface of the thigh and the high number of fourth toe lamellae. The *euryotis* group is a monothetic group based on the reduction of the anterior loreal, and as such, *L. alazon* does not belong with this group. It is further excluded from the *euryotis* group by differences in habitus and associated scale characters, e.g., dorsal scale rows and fourth toe lamellae (see Tables 1 and 2). *Leiolopisma deplanchei*² and *L. alazon* have little in common aside from body shape and relative limb length. The *austrocaledonicum* group is a diverse complex of species and populations; they share general features such as loreal shape and number of supralabials with *L. alazon*, but differ in many other features including habitus.

Since *Leiolopisma alazon* has no obvious affinities with the New Caledonian *Leiolopisma*, a brief comparison with the New Zealand leiolopismine skinks is appropriate. Considering New Zealand as a “source” area, however, assumes a much more ancient arrival of *Leiolopisma* into the Lau group and a biogeographical explanation based on vicariance rather than long-distance dispersal (Springer 1982). Such an explanation suggests an arrival (in the Fiji area, not the Lau group specifically) time of 20–50 million years ago during the formation of the Melanesian marginal sea (Crook and Belbin 1978). This interpretation would indeed make *Leiolopisma* an old lineage, but this is not discordant with its presumed primitiveness relative to other lygosomine skinks (Greer 1974) or the age of many extant genera of lizards (Estes 1983).

The New Zealand “leiolopisma” skinks possess primitive traits relative to most of their Australian and New Caledonian congeners (Hardy 1977). *Cyclodina* has

² *Leiolopisma deplanchei* Bavay (1869:23) is a small lizard with an elongated cylindrical trunk and short limbs, and it is the *L. deplanchei* referred to herein. *Leiolopisma deplanchei* Bocage (1873:229) is a junior homonym and refers to a large lizard with long limbs; the original description suggests that Bocage's name is a junior synonym of *L. nigrofasciolatum* Peters (1869). Roux (1913:115) similarly identified *deplanchei* Bocage as a synonym of *nigrofasciolatum* Peters.

Table 2.—Head and body scalation. The taxa (given in abbreviated form) are arranged in the same order as the preceding table.

Characters	ala	aus	dep	eur	gre	nig	nov	ste	tri	var
Frontoparietal	2	1	1	1	2	2	1	1	1	1
Prefrontals										
Size (S, M, L)	M	S, M	M	M	L	L	L	L	L	L
In contact	—	—	—	—	+	+	—	—	—	—
Nasals										
divided	—	+	±	—	—	—	—	—	+	+
Naris central										
Loreals	+	—	+	+	+	—	+	+	+	—
Anterior										
Posterior	h > w	h > w	h > w	h > w	w > h	w > h	w > h	reduced	h = w	h = w
Preculars	w > h	w > h	h > w	h = w	w > h	w > h	w > h	h = w	w > h	w > h
Subocular row	2	2	2	2	2	1-3	2	2	2	2
Supraciliaries	comp	inc	inc	comp	inc	inc	inc	inc	comp	inc
Temporals	8-9	7-8	8	8	?	9-10	8	8	8-9	8
Primary	1	1	1	1	?	2-3	1	1	1	1
Secondary	2	2	2	2	?	≥3	2	2	2	2
Supralabials										
Modal #	7	7	7	7	8	9	7	7	7	8
In orbit	V	V	V	V	VI	VII	V	V	V	VI
Infralabials	5-7	6-7	6	6	?	8-10	6	6	6-7	6-8
Nuchals	pr	pr	pr	pr	pr	pr	pr	pr	none	pr
Dorsal scale										
rows	71-75	55-61	48-49	50	?	78-95	?	51-55	63-66	45-54
Midbody scale										
rows	34-37	25-33	28	34	35	34-39	32	34-35	38-42	35-39
Fourth finger										
lamellae	12-15	15-19	13-14	18	?	21-25	?	21-22	17-20	21-25
Fourth toe										
lamellae	20-22	24-32	25-28	32	23	30-35	22	37-39	29-33	37-42
Keels on dorsal										
scales	0	3-4	0	3	0	0	3-5	0	3-5	3
Preenals										
enlarged	+	+	—	—	+	—	—	—	—	—

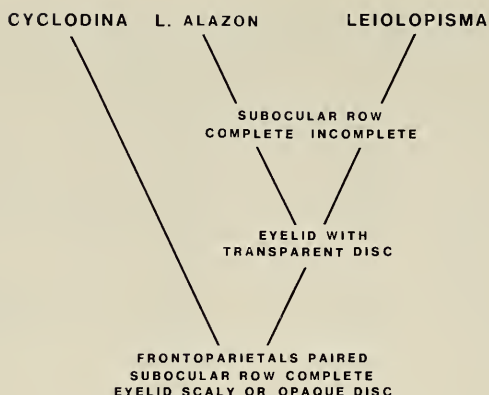


Fig. 4. Phenetic relationships of New Zealand "leiopisma" and *L. alazon*. Hardy's dendrogram (1979:fig. 2) suggests *Cyclodina* as a derived form owing to chromosome morphology. Pericentric inversion of chromosome pairs 7 and 8 would support the close relationship of *L. alazon* with *Cyclodina*.

a scaly, opaque lower eyelid and paired frontoparietals; two characters assumed to be primitive for "leiopisma" skinks. Although *L. alazon* does not share the eyelid character, it does have paired frontoparietals. Furthermore, *L. alazon* shares numerous other characters with the species of *Cyclodina*: moderate to large prefrontals, large anterior and posterior loreals, complete subocular row beneath eye, high numbers of dorsal and midbody scale rows, low number of fourth toe lamellae, habitus, and general coloration, particularly orange tinted tails. Overall, *L. alazon* appears to be most similar to *C. whitakeri*. In contrast, *L. alazon* shares fewer features with the New Zealand *Leiopisma*; the transparent palpebral disc of the lower eyelid is the most noticeable exception. The New Zealand *Leiopisma* have larger body sizes (> 70 mm SVL) and incomplete subocular rows; most tend to have slender bodies and longer limbs. Nonetheless, some species, e.g., *L. lineocellatum* and *L. suteri* do share similar scale counts and habitus with *L. alazon*. Thus, the data suggest the derivation of *L. alazon* from a New Zealand "leiopisma" stock (Fig. 4).

The greater similarity of *L. alazon* to the New Zealand *Cyclodina* than to the New Zealand *Leiopisma* emphasizes the need for a re-evaluation of the relationships of the "leiopisma" skinks. The diversity of the New Caledonian *Leiopisma* and the apparent structural divergence of the different species and species groups similarly encourages such a re-evaluation.

Acknowledgments

The specimens of the new species were collected during a herpetological and ichthyological survey of Fiji sponsored by the Max and Victoria Dreyfus Foundation and the Smithsonian Scholarly Studies Program, with logistic support from the Marine Laboratory of the Fijian Ministry of Agriculture and Fisheries and the School of Natural Resources, The University of the South Pacific. The support from these institutions and associated individuals is much appreciated. I also wish to thank my colleagues on the "Blue Dolphin" for their companionship and

cooperation during the Lau voyage, C. A. Ross for his assistance and encouragement in the analysis of the *Leiopisma*, and W. C. Brown, R. I. Crombie, G. S. Hardy, W. R. Heyer, R. Sadlier, and V. G. Springer for their constructive reviews of the manuscript. Colleagues in other museums have been most helpful in loaning specimens; I wish to thank E. N. Arnold (British Museum (Natural History)), E. J. Censky and C. J. McCoy, Jr. (Carnegie Museum of Natural History), H. K. Voris (Field Museum of Natural History), P. Alberch and J. P. Rosado (Museum of Comparative Zoology, Harvard University), E. R. Brygoo (Muséum National d'Histoire Naturelle), and D. M. Harris and A. G. Kluge (University of Michigan, Museum of Zoology).

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